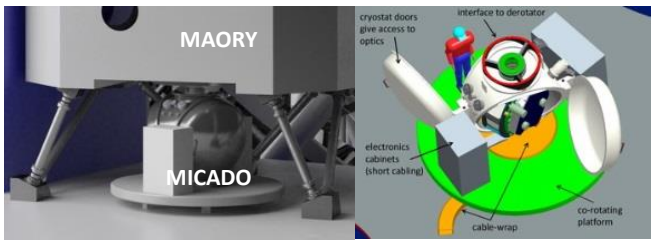
ESO E-ELT INSTRUMENT



INSTRUMENT ACRONYM and FULL NAME:

MICADO - the **M**ulti-AO **I**maging **CA**mera for **D**eep **O**bservations

SCIENTIFIC OBJECTIVES:

- to study the environment and internal structure of galaxies and AGN at high redshift, using its wide field, high resolution, and remarkable sensitivity;
- to derive star formation history of local galaxies through studies of spatially resolved stellar populations, using its ability to perform accurate photometry in highly crowded fields;
- to trace the orbits and internal kinematics of nearby galaxies and star clusters, and to probe ever c loser to the central massive black hole in the Galactic Centre, using the exquisite astrometric accuracy

SPECS & TECHNICAL CHALLENGES (R&D needed, procurement opportunities):

MICADO is optimised for the multi-conjugate adaptive optics module MAORY; but it is also able to work with other adaptive optics systems, and includes a separate module to provide a single conjugate adaptive optics capability using natural guide stars during the early operational phase. MICADO is a simple camera and given the fact that MAORY is a first-light instrument, its baseline design is based on proven technologies as far as possible:

- Cryostat : Cryostat & Cryogenics, Handling Equipment, MICADO Test Facility
- Opto-Mechanics: Common path, Primary Arm, Auxiliary Arm, Calibration Unit
- Detectors: Focal Plane Array
- Electronics: Instrument Control, Housekeeping
- Software: instrument Software, Data Processing
- SCAO: Support Structure, Optical Relay, Wavefront Sensing, SCAO Test Facility

Sensitivity and Resolution

MICADO is optimised for imaging at the diffraction limit, and will fully sample the 6-10mas FWHM in the J-K bands. With a throughput exceeding 60% its sensitivity at 1-2micron will, for the AO performance predicted by MAORY, be comparable to, or surpass, JWST even for isolated point sources, and be clearly superior to JWST in crowded regions.

After Phase A, the consortium will pursue a project to develop OH suppressing filters that could further improve the sensitivity by a significant factor. In addition, its field of view of nearly 1 arcmin yields a significant multiplex advantage compared to other ground-based cameras such as IRIS on the TMT. Together, these characteristics make MICADO a powerful tool for many science cases, from studies of faint high redshift galaxies to performing photometry in crowded fields. In important issue

in this respect is the availability of tools to extract and measure point sources, and so the consortium has initiated a study to assess the suitability and future requirements of photometry packages.

Precision Astrometry

The primary imaging field of MICADO employs a catoptric design using only fixed mirrors. Together with the gravity invariant rotation and the baseline to use HAWAII-4RG detectors (developed to meet the stringent requirements of space astrometry missions. A robust pipeline, based on software already available in the AstroWISE system, will bring precision astrometry into the mainstream. An analysis of the statistical and systematic effects shows that proper motions of 40microarcsec/yr in a single epoch of observations should be achievable; and after only 3-4 years it will be possible to reach 10microarcsec/yr, equivalent to 5km/s at 100kpc.

High Throughput Spectroscopy

A simple slit spectrometer with a high throughput is ideal for obtaining spectra of compact objects. The resolution of R~3000 is sufficient to probe between the near infrared OH lines.

POINT OF CONTACT:

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CONSORTIUM (Phase A study):

- MPE Max-Planck-Institut für extraterrestrische Physik
- MPIA Max-Planck-Institut für Astronomie
- USM Universitäts-Sternwarte München
- NOVA Nederlande Onderzoekschool voor Astronomie (specifically including University of Leiden, University of Groningen, NOVA optical/IR instrumentation group)
- OAPD Osservatorio Astronomico di Padova, INAF
- LESIA Laboratoire d'Etudes Spatiales et Instrumentations pour l'Astrophysique, Paris Observatory

WEBSITE:

http://www.mpe.mpg.de/ir/micado

TIMELINE:

- Phase 1: MICADO + SCAO (a more simple form of adaptive optics)
- Phase 2: MICADO + MCAO

Expected project Phase B kick-off: October 2015. Instrument Phase 1 delivery and commissioning: as required for E-ELT first light.